

LOWER WEBER RIVER SUB-WATERSHED PLAN



**Development of a Strategy to reduce Non-point Source Pollution in the
Weber River Segment 3
from Ogden to Cottonwood Creek, Utah**

January 2019

EXECUTIVE SUMMARY

The Weber River is a vital river corridor that serves over 1.8 million residents in Northern Utah, about 21% of Utah's population (Weber River Watershed Plan, 2014, UDWR). The Weber River Watershed has been divided into six distinct Ecological Systems to facilitate planning and assessments (WRWP, 2014). The Lower Weber River Ecological System is defined as the reach that runs from the confluence with East Canyon Creek down to the Great Salt Lake at Willard Bay. Within the Lower Weber River Ecological System is Segment 3, listed in 2008 as 303(d) impaired for not meeting aquatic life beneficial uses. A Total Maximum Daily Load has not been developed for Segment 3. This report covers Segment 3 in the Lower Weber River Ecological System and provides a basis for conducting river restoration actions designed to improve non-point source water quality in three distinct reaches. Reach 1 includes the main stem of the Weber River from the confluence with the Ogden River up to the Ogden City limits; Reach 2 includes the river from the Ogden City limits up to the mouth of Weber Canyon; and Reach 3 includes the river from the mouth of Weber Canyon up to the confluence with Cottonwood Creek (Figure 1).

The purpose of this Lower Weber River Sub-Watershed Plan is to provide a living watershed restoration plan document for the City of Ogden and other project partners to develop and implement best management practices that will reduce non-point source pollution loading, improve the water quality, and reduce impairments to aquatic life beneficial uses. This sub-watershed is at the core of the Weber River where it serves the greatest population in Northern Utah. The City of Ogden and other land managers along this segment have embraced the river corridor and plan to continue restoration efforts that benefit the social, economic, and environmental values of a healthy river system. The objective of this plan is to provide specific recommendations to assist in the planning, implementation, and adaptive management to improve Weber River-Segment 3 and meet water quality standards. Opportunities exist to reduce non-point source pollution by planning from the river out, and restoring natural channel functions that support aquatic, biologic, and social needs. This document is intended to provide a base plan for future efforts that may expand over the entire Lower Weber River Ecological System, as well as link to other reaches and tributaries in the watershed.

The goals of this plan are to:

- a.) Identify degradations causing water quality impairments;
- b.) Develop an implementation strategy to improve water quality and reduce NPS loading;
- c.) Develop water quality criteria to measure success; and
- d.) Assist stakeholders with achieving the objectives of this plan.

Ogden City enlisted RiverRestoration to inventory and evaluate the opportunities for river enhancements within the river corridor in Reach 1, which include improvements to floodplain capacity and condition, fish and wildlife habitats, and recreational improvements designed to help the community connect to the river and its associated resources. The City of Ogden has worked to develop conceptual plans for specific reaches of the Weber River and is working to repeat the successful restoration actions that were completed on the Ogden River in 2011. A set of conceptual plans for these river improvements are included in Appendix A. Reaches 2 and 3 are also proposed

for water quality improvements, but limited engineering work has been completed, thus no detailed concepts or plan sets are provided in this report.

Through the Weber Partnership and other groups working together along the Weber River, a collective vision for improvement of degraded conditions was developed for the river in the last decade (WRWP, 2014). The Weber Partnership has held an annual meeting called the *Weber Confluence*, which has brought stakeholders from across the watershed to participate in education and outreach opportunities over the last three years. Additionally, the *Weber River Strong* effort in 2015 brought stakeholders together to identify important projects across the watershed. Through these efforts and directed outreach, the projects identified in this sub-watershed plan have been developed and concepts vetted with participants. Work continues to identify actions that will improve water quality and educate the public on the benefits of river corridor restoration through the urbanized areas in the Lower Weber River. The following list of stakeholders is involved in the effort and continues to work together to identify opportunities to improve the water quality, habitat integrity, and public access to this vital resource.

List of Key Stakeholders:

- Ogden City
 - Weber County
 - Weber River Partnership
 - Utah Department of Environmental Quality, Division of Water Quality
 - Trout Unlimited
 - Utah Office of Outdoor Recreation
 - Utah Division of Wildlife Resources
 - Utah State University Extension
 - Utah Conservation Corps
 - Weber Pathways
 - Central Weber Water Conservation District
 - Union Pacific Railroad
 - Utah Department of Transportation
 - U.S. Fish and Wildlife Service
 - U.S. National Park Service – Recreation, Trails, and Conservation Association
 - Land owners
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The EPA requires that nine elements be included in watershed plans that are developed, where Clean Water Act Section 319 funds are proposed to be used for water quality improvement actions. This plan addresses those nine elements and provides a framework for implementation of actions over the period of 2017-2021. Work will continue after 2021, but that work is anticipated to be based on the monitoring results and adaptive management recommendations to continue to implement BMP's to improve water quality conditions. The table below provides a summary of the 9-elements and their location in this document.

EPA 9-elements		
Element	Description	Location in Document
Element 1	Causes of impairment	Section 3 - page 15
Element 2	Load reductions	Section 4 - page 17
Element 3	Description of management measures	Section 4 -page 19
Element 4	Estimate of technical and financial assistance needed	Section 4 - page 27
Element 5	Education	Section 8 - page 33
Element 6	Schedule	Section 4 - page 28 - table 2
Element 7	Milestones	Section 4 - page 28
Element 8	Criteria	Section 5 - page 30
Element 9	Monitoring	Section 9 - page 35

1. WATERSHED DESCRIPTION

The Weber River Watershed encompass approximately 1.5 million acres of land in northern Utah, including portions of Summit, Weber and Davis counties and all of Morgan County (Weber River Watershed Plan, 2014). The Weber River Watershed Plan (WRWP) delineates 42 miles of the mainstem as the Lower Weber River Ecological System, including 344 square miles of drainage area and includes the entire Lower Weber River from the confluence with East Canyon Creek down to the Great Salt Lake (WRWP, 2014).

The Lower Weber River between the mouth of Weber Canyon and the confluence with the Ogden River has been identified as an important corridor for both humans and ecological systems. This reach has been recognized by the Utah Department of Wildlife Resources (UDWR) as a significant stronghold for Bluehead sucker (*Catostomus discobolus*) and provides a critical link in aquatic and riparian habitats stretching between the Wasatch Front and the Great Salt Lake. Several regional partnerships have been working to improve the function and conditions of the river to correct historical alterations that have degraded water quality and habitat. Additionally, the City of Ogden has been working with numerous partners to develop a vision and goals for restoring a healthy river corridor through what is arguably the most degraded reach of river in the entire Weber Basin. This Plan provides a basis for improving the river ecosystems over the next five to ten years.

Within the Lower Weber River Ecological System, is Weber River-Segment 3, as delineated by the UDWR, and includes the mainstem of the Weber River from the confluence with the Cottonwood Creek down to the confluence with the Ogden River. The focus of this Lower Weber River Watershed Plan is this reach, which is close to the most urbanized segment of the Weber River identified as - UT 160201102-002. This plan focuses on a 17.7-mile reach of the mainstem; approximately 463 acres of river and riparian area within the three reaches together. The study reach extends from the confluence with the Ogden River along the Weber River main stem up to the confluence with Cottonwood Creek (Figure 1).

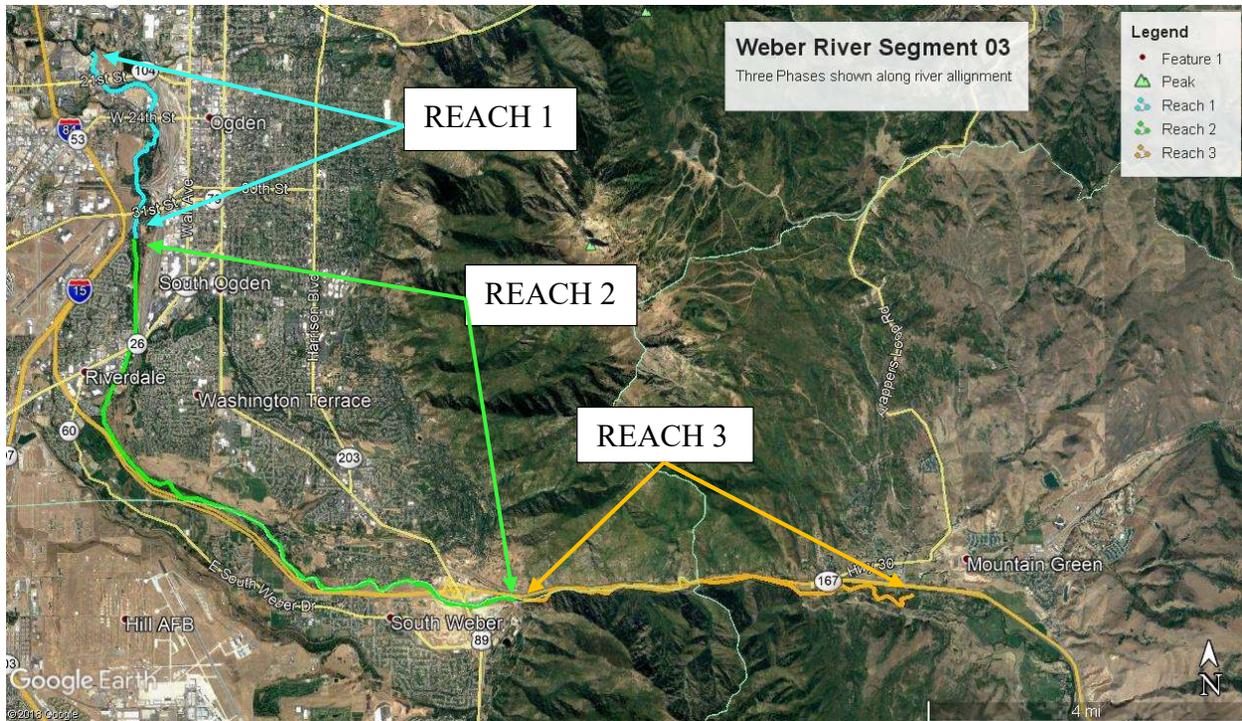


Figure 1. Lower Weber River Restoration Project Area Reaches. The listed cause of impairment for UT16020102-002 (Weber River – Segment 3), which includes the project area, is Benthic Macroinvertebrates Bioassessments. The causes of impairment for UT16020102-001, which is downstream from the project area, are Benthic Macroinvertebrate Bioassessments and Total Ammonia (<https://watersgeo.epa.gov/mywaterway/rdetail2.html>)

HYDROLOGY

The Weber River at Ogden City drains an area of approximately 1,700 square miles. There are two major impoundments that control flows on the Weber River, the Rockport and Echo Reservoirs. However, these impoundments are located too far upstream to help control flood flows in the Lower Weber River system. There are several diversion structures for agricultural and municipal uses. Water delivery for agricultural uses sustain flows during the growing season, creating a hydrograph that has less peaks and greater base flows.

Average daily flows within the Sub-Watershed are estimated using the USGS gage station at Gateway (10136500) in the Weber Canyon (Figure 2). During the irrigation delivery period, flows are estimated to be 150cfs less than measured at the gage from approximately April 15th to October 16th, each year; (Reed Cozens, Weber River Water Commissioner, 2013). The 100-year flood flow event is estimated as 7,000 cfs, FIS, FEMA, 2005.

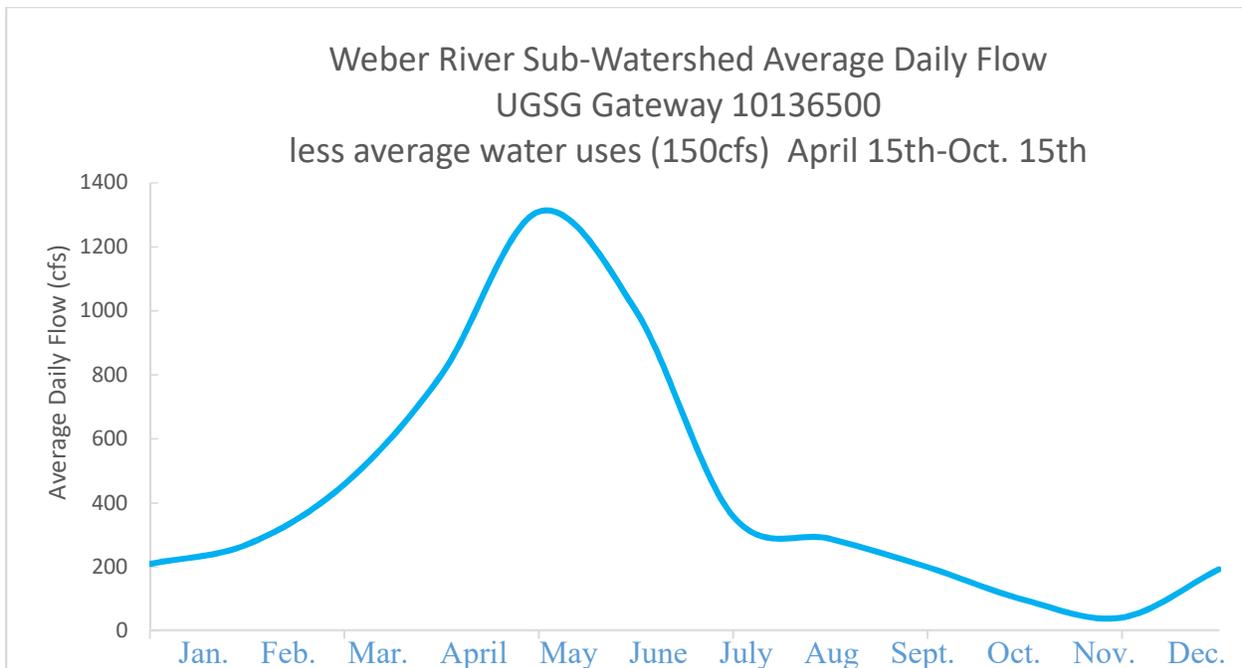


Figure 2. Hydrology of the Weber River

GEOMORPHOLOGY

The Weber River originates in the Uinta Mountains and flows approximately 128 miles north and west cutting through the Wasatch Mountains before entering the study reach in the Great Salt Lake Valley. The Weber River-Segment 3 is characterized as the depositional zone for the watershed. During the Pleistocene epoch, Lake Bonneville covered the area between Wasatch Front and what is now the Great Salt Lake. As the Weber River discharged into Lake Bonneville it formed large delta deposits. Local geology indicates that Lake Bonneville advanced and receded several times over the past three million years; geologists estimate that the lake level stood nearly 1,000 feet higher than the current level of Great Salt Lake. Approximately 17,400 years ago a large flood event occurred, breaching alluvial deposits, causing Lake Bonneville to drain through the Red Rocks Pass in Idaho. This destructive flood lasted several weeks causing significant landform changes all the way to the Columbia River near Pasco, Washington. The level of Lake Bonneville continued to rise and fall several times to reach its present quasi-equilibrium level of the current Great Salt Lake. Historically the Weber River formed multiple cobble deltas as it meandered through the alluvial valley and responded to different lake levels. The Weber River's natural process has an ever-changing meandering planform and forms multiple channels as it cuts through these old delta and lakeshore deposits.

Ogden City extends from the base of the Wasatch Front and into the alluvial valley. The Weber River is a dynamic alluvial system with a highly mobile riverbed. As the river deposits alluvium in one location, the bed aggrades, and the river is forced to flow in another direction. Near Ogden City the Weber River's floodplain and meander belt width historically averaged 1500-ft wide. As the valley has been urbanized over the past 100 years the river has been confined to a floodplain that ranges from 10-ft to 300-ft.

As the community developed, the river was encroached and straightened. Aerial photographs from 1953, 1954, 1971, 1973, 1979, 1980, 1997, 2003, 2006, and 2009 were reviewed to understand the geomorphic evolution of the Weber River. In the photos from the 1953 and 1954 it is apparent that Ogden City was largely an agricultural community with farmlands dominating the landscape. While the river was somewhat constrained by the railroad and Highway it was free to migrate across much of the valley. Historic flow paths are evident throughout the 1953 photo. The length of the Ogden City reach has been reduced by approximately 20%. The average sinuosity of the reach has been reduced from more than 1.53 to less than 1.14. This also means that the river has been steepened by 20%, exacerbating channel degradation creating a more narrow and deep channel. There is a decreased connection between the main channel and the floodplain. Side channels that were once available to convey flood flows have either been filled or they have become disconnected from the main channel. These hydromodifications have increased the shear stress on the bottom and banks of the channel. This process has pushed the Weber River across a threshold that no longer functions naturally. The natural process of aggrading the channel, eroding banks and forming new channels, floodplains, and point bars is significantly altered. A channel would be in dynamic equilibrium when sediment discharge, particle size, streamflow and stream slope are in balance. The Weber River channel is no longer stable. Now this reach of the river has a much greater sediment transport capacity. The Weber River conveys heavy bedload, has steep bank slopes and is comprised of poorly consolidated soils. In many areas, there is insufficient vegetation to support the banks while in other areas the riparian vegetation is extremely dense, encroaches on the river, and limits the ability of the over bank areas to convey flood flows and sediment. Adjacent development has responded to the increase in stream power, where significant portions of the river bank have been hardened to control overbanking flood flows and channel migration.

The Rockport and Echo impoundments upstream have also altered the natural hydrograph of the Weber River. Duration of channel forming flows has likely been reduced by the need to manage flows for municipal and agricultural uses. The prolonged drought period from the early 2000s to 2010 limited overbank disturbance. The lack of channel forming flows allowed vegetation to encroach the channel. During this period, the river became significantly more overgrown further narrowing the channel and decreasing overbank processes important for sediments deposition, conveyance of flood flows, backwater refuge, and wetland connection.

PHYSICAL CHARACTERISTICS

The physical characteristics of the entire Weber River Watershed were evaluated in the Weber Basin Watershed Plan (UDWR, 2014). The specific reach of the Weber River through the City of Ogden has been further evaluated and the land cover estimates are provided below.

- 2011 National Land Cover Dataset (class code):
 - Open Water (11): 0%
 - Low Intensity Residential (21): 5%
 - Commercial (23): 18.4%
 - Deciduous Forest (41): 17.1%
 - Evergreen Forest (42): 13%
 - Mixed Forest (43): 0%
 - Other: 46.5%

VEGETATION

Although riparian areas represent less than one percent of the land within Utah, they are among the most diverse and densely used wildlife habitat in this region. Animals including migratory songbirds, deer, elk and amphibians rely on these riparian corridors for food, cover, breeding habitat and movement corridors. Riparian areas also provide many important functions to humans, from recreation to providing clean and abundant water, to reducing flooding.

Riparian forest species such as Fremont Cottonwoods (*Populus fremontii*) and sandbar willow (*Salix exigua*) have evolved with channel migration as a critical component of their life cycle. High flows during spring runoff mobilize sediments at the edge of active channels and create point bars. Additionally, overbank flows may scour areas of vegetative cover and mulch. These exposed areas are essential for cottonwood establishment. The cottonwood seeds are deposited in these areas which remain wet as the river recedes. The seeds germinate during this period and grow a tap root that follows the water table as the hydrograph declines, creating new riparian forests. These forests in turn capture sediment and retain floods. Many other plant and animal species are similarly adapted to this dynamic environment. See Appendix B for an inventory of the riparian areas identified in this sub-watershed plan.

The aggradation of historic flow paths and the resultant migration of the river to new flow paths create a mosaic of diverse habitat. Some remnant channels remain open, filling with water and becoming oxbow lakes or wetlands. Newly exposed point bars provide new habitat for riparian plants. This natural process for a diverse and functioning riparian and wetland habitat has been lost due to NPS hydromodification.

WILDLIFE (BIRDS, FISH, LAND ANIMALS, AND PROTECTED SPECIES)

The Weber River through the City of Ogden hosts a variety of wildlife, but habitats in the corridor are limited by encroachment of anthropogenic disturbances including roads, bridges, channelized sections, and other hydrological alterations. The following list was developed from the U.S. Fish

and Wildlife Service iPAC system and Utah Department of Natural Resources Natural Heritage system and a full list of species is contained in Appendix B. Formal consultation will be completed with both agencies before any work begins.

Birds

- Yellow-billed Cuckoo (*Coccyzus americanus*). Status – Federally Threatened. There are a few contiguous riparian areas that meet the *Minimum Requirements for YBC Habitat Suitability* (USFWS, 2012), but no cuckoos have been observed with callback surveys (Pers. Comm. Adam Brewerton). Any proposed work will occur in consultation with the Utah Ecological Services office of USFWS.
- A list of 29 migratory bird species ranges also overlap with the project area. The project has the potential to benefit several of these species including: American Bittern (*Botaurus lentiginosus*), Bald Eagle (*Haliaeetus leucocephalus*), Black rosy-finch (*Leucosticte atrata*), Brewer’s Sparrow (*Spizella breweri*), Lewis’s Woodpecker (*Melanerpes lewis*), Olive-sided Flycatcher (*Contopus cooperi*), Swainson’s Hawk (*Buteo swainsoni*), Virginia’s Warbler (*Vermivora virginiae*), and Willow Flycatcher (*Empidonax trailii*).
- American White Pelican (*Pelecanus erythrorhynchos*). Status – Utah Sensitive. Pelicans likely use ponds adjacent to the Weber River in the project location.

Mammals

- Canada Lynx (*Lynx canadensis*). Status - Threatened. There is no suitable habitat for Canada Lynx in the project area.
- Townsend’s Big-eared Bat (*Corynorhinus townsendii*). Status – Utah Sensitive. The last observation of Townsend’s Big-eared Bats was pre-1980, but more recent surveys have not been completed. Improvements in riparian habitats have the potential to benefit this species and other bats.

Fish

- Bonneville Cutthroat Trout (*Oncorhynchus clarkii Utah*; BCT). Status – Utah Sensitive (G4T4; S4). BCT have been observed in the Weber River and are a primary focus of restoration efforts. These fish eat macroinvertebrates and the water quality degradations and habitat alterations have likely diminished the health of the fishery.
- Bluehead Sucker (*Catostomus discobolus*; BHS). Status – Utah Sensitive (G4; S3). The BHS was previously thought to not inhabit the Lower Weber River, but have been observed in recent surveys by Brian Mahoney at Utah State University (Maloney, 2016). The Utah DNR has identified the proposed project reach as a top priority for habitat restoration, with a focus on creating more BHS rearing habitat (slow flowing backwaters), which will also be beneficial for macroinvertebrates.

Invertebrates

- Lyrate Mountainsnail (*Oreohelix haydeni*). Status – Utah Sensitive (G2G3; S2). Only observations pre-1929.

2. WATERSHED WATER QUALITY CONDITIONS

The Utah Department of Environmental Quality conducts assessments of the beneficial uses biennially, consistent with EPA requirements under section 303(d) and 305(b) of the federal Clean Water Act (33 U.S.C. 1313(d) and 1315(b)). A biological assessment conducted by the UDEQ between January 1, 2002 and December 31, 2006 evaluated impairments within the Weber River Watershed Management Unit (HU 16020101/02). Weber River-Segment 3 was listed as 303(d) impaired based on narrative standards and biological integrity for macroinvertebrates (data in Appendix C). A TMDL for Weber River-Segment 3 has not been completed.

WATER QUALITY STANDARDS

It is Utah's public policy to conserve the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses; to provide that no waste be discharged into any waters of the state without first being given the degree of treatment necessary to protect the legitimate beneficial uses of such waters; to provide for the prevention, abatement and control of new or existing water pollution; to place first in priority those control measures directed toward elimination of pollution which creates hazards to public health; to insure due consideration of financial problems imposed on water polluters through pursuit of these objectives; and to cooperate with other agencies of the state and agencies of other states and the federal government in carrying out these objectives. Water quality standards are reviewed and updated at least once every three years (Utah Water Quality Standards Rule 317-2, 2014).

The Lower Weber River Ecological System is classified as a Category 2 Water from Uintah to Mountain Green. Category 2 waters afford a high level of protection, but unlike Category 1 Waters discharges to these waters are permissible, provided no degradation of water quality will occur or where pollution will result only during the actual construction activity, and where best management practices will be employed to minimize pollution effects. Category 2 Waters are designated surface water segments which are treated as Category 1 Waters except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality (Utah Water Quality Standards Rule 317-2, 2014).

The Weber River-Segment 3 is listed as a Category 3 Water, whereas point source discharges are allowed and degradation may occur, pursuant to the conditions and review procedures outlined in Antidegradation Review (ADR). An antidegradation review will determine whether the proposed activity complies with the applicable antidegradation requirements of receiving waters that may be affected. An ADR may consist of two levels for review and shall include opportunities for public participation. Activities subject to ADR are typically reviewed under CWA section 401 (FERC and other federal actions), 402 (UPDES permits), 404 (Army Corps of Engineers) permits. The intent of the ADR is to ensure that when degradation of water quality is necessary for social and economic development, every feasible option to minimize degradation is explored. Existing designated water uses shall be maintained and protected. Diffuse sources (nonpoint sources) of wastes shall be controlled to the extent feasible through implementation of BMPs or regulatory programs (Utah Water Quality Standards Rule 317-2, 2014).

Water quality standards are defined by numeric criteria and narrative standards. Beneficial uses for domestic and agriculture uses were determined to be fully supporting in Segment 3.

Recreational uses have not been assessed. Impairment to Aquatic Life beneficial uses was determined using the states Narrative Biological Standards protocol. The Narrative Biological Standard is summarized as: The taxonomic composition, richness or functional organization of an assemblage of aquatic organisms shall not differ from comparable measures observed at reference sites. This criterion shall be determined using scientifically defensible and statistically rigorous methods and other information to assess support of biological uses as assigned in R-317-2-6. Biological assessment methods may also be used, in combination with other information, to support the development of site-specific standards, new or refined aquatic life use categories, or to support the need for new permit limits.

DESIGNATED BENEFICIAL USES

Weber River Segment 3 designated beneficial uses are classified as:

2B Recreation and Aesthetics: protected for infrequent primary contact recreation; where there is low likelihood of ingestion of water or low degree of bodily contact with the water such as; recreational boating, water skiing, wading, and similar uses, excluding recreational swimming/bathing.
3A Aquatic Wildlife: protected for cold water species of game fish and other coldwater aquatic life including the necessary aquatic organisms in their food chain.
4 Agricultural Uses: protected for agricultural uses including irrigation of crops and stock watering.

WATER QUALITY IMPAIRMENTS

Weber River-Segment 3 (AU ID: UT16020102-002_00) encompasses 17.86 miles of the mainstem that runs from the Ogden River confluence to the Cottonwood Creek confluence. The cause of impairment to Cold Water Aquatic Life beneficial uses was based on Benthic-Macroinvertebrate Bioassessments. The UDWQ conducted kick-net sampling of riffles in the Weber River and the observed (O) macroinvertebrate assemblages were compared with expected (E) species using a predictive model (O/E ratio; Figure 3). Assessment of macroinvertebrate populations concluded a shift of the assemblage from shredder domination to grazer domination and a decrease in diversity.

Water quality data has been compiled by the UDWQ and further evaluation of the macroinvertebrate populations will be completed in partnership with the Western Center for Monitoring & Assessment of Freshwater Ecosystems and Utah Water Watch. Weber Basin Water Conservancy District also collects water quality in this reach and a Sampling and Analysis Plan (SAP) will be developed with input from project stakeholders.

Based on studies in other watersheds (Hawkins, 2016) degradation observed in the Lower Weber River is assumed to be due to factors related to urbanization including hydromodification of the stream channel through channelization, straightening, and levee installation. These hydrological modifications have reduced the floodplain connectivity and diminished the value of riparian areas adjacent to the river.

Initial evaluation of habitat conditions related to benthic macroinvertebrates (Barbour *et al.* 1999) indicate that several habitat characteristics in the project area have been moderately to highly degraded and will benefit from restoration. Specifically, the following habitat/physical characteristics related to water quality are suboptimal to poor in the project area: epifaunal substrate/available cover; channel alteration; bank vegetation protection; riparian vegetation zone width; habitat complexity and cover; riparian vegetation cover and structure; anthropogenic alteration (particularly encroachment of development and bank hardening), and channel-riparian interaction (Figure 3). Other habitat/physical characteristics of the stream channel are also suboptimal to poor, including embeddedness; pool substrate; pool variability; and sediment deposition.

Initial baseline inventory of riparian areas was completed in 2016 and 2017 with riparian and stream surveys in the Ogden City reach. will be completed using the Wild Utah Project Rapid Stream Riparian Assessment Methodology in 2019, prior to work on the CWSID 36" sewer line crossing. Further assessment of habitat/physical characteristics related to water quality will be completed in 2019-2021 and after restoration actions have been implemented. Figures 3-10 show areas impacted by urbanization in the Ogden City Reach. Figure 11 provides a map of proposed improvements planned over the next several years by Ogden City and partners in Reach 1.

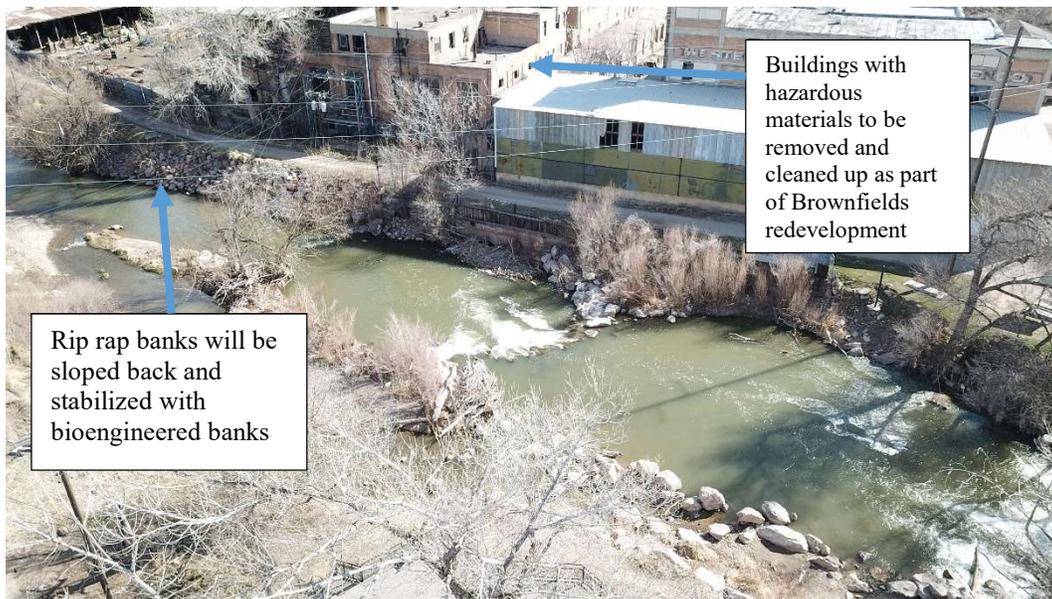


Figure 3. Photo illustrating anthropogenic alteration, impaired riparian habitat vegetative cover and structure, and degraded channel-riparian interactions (March 13, 2018; photo 0123). Buildings on the far bank will be removed, bank slopes decreased, and desirable riparian vegetation will be planted.



Figure 4. Photo illustrating anthropogenic alteration, impaired riparian habitat vegetative cover and structure, and degraded channel-riparian interactions. Buildings on the far bank will be removed, bank slopes decreased to approximately 3:1, and desirable riparian vegetation will be planted to increase the riparian buffer along the Weber River.



Figure 7. Photo illustrating anthropogenic alteration of the stream corridor (March 13, 2018; photo 0288). Bridges represent sources of water quality impairment. While bridges may not be moved, other restoration actions in the area can help to mitigate for the effects of the bridges. Rapids just to the right of the furthest right bridge show an exposed, large-diameter pipe that spans the river and needs to be protected.



Figure 8. Photo illustrating Central Weber Sewer Improvement District 36" line being undermined with scour under current conditions. Sewer line will be protected with improved vertical grade control to reduce risk of catastrophic failure, which would result in the discharge of sewage into the Weber River.



Figure 9. Photo illustrating suboptimal to marginal epifaunal substrate/available cover, anthropogenic alteration, and degraded riparian vegetative cover and structure (March 13, 2018; Ph 0152). The portion of the reach shown in this photo is typical of the project area regarding a need for greater epifaunal cover such as snags, submerged logs, undercut banks, etc. Riparian forest here as elsewhere in the project area have been degraded and will be enhanced.



Figure 10. Photo illustrating anthropogenic alteration, suboptimal epifaunal substrate/available cover (March 13, 2018; Phs 0182 & 0200). Riparian zone width is only several meters where development encroaches from the left (inset), as is also found in other places in the project area.

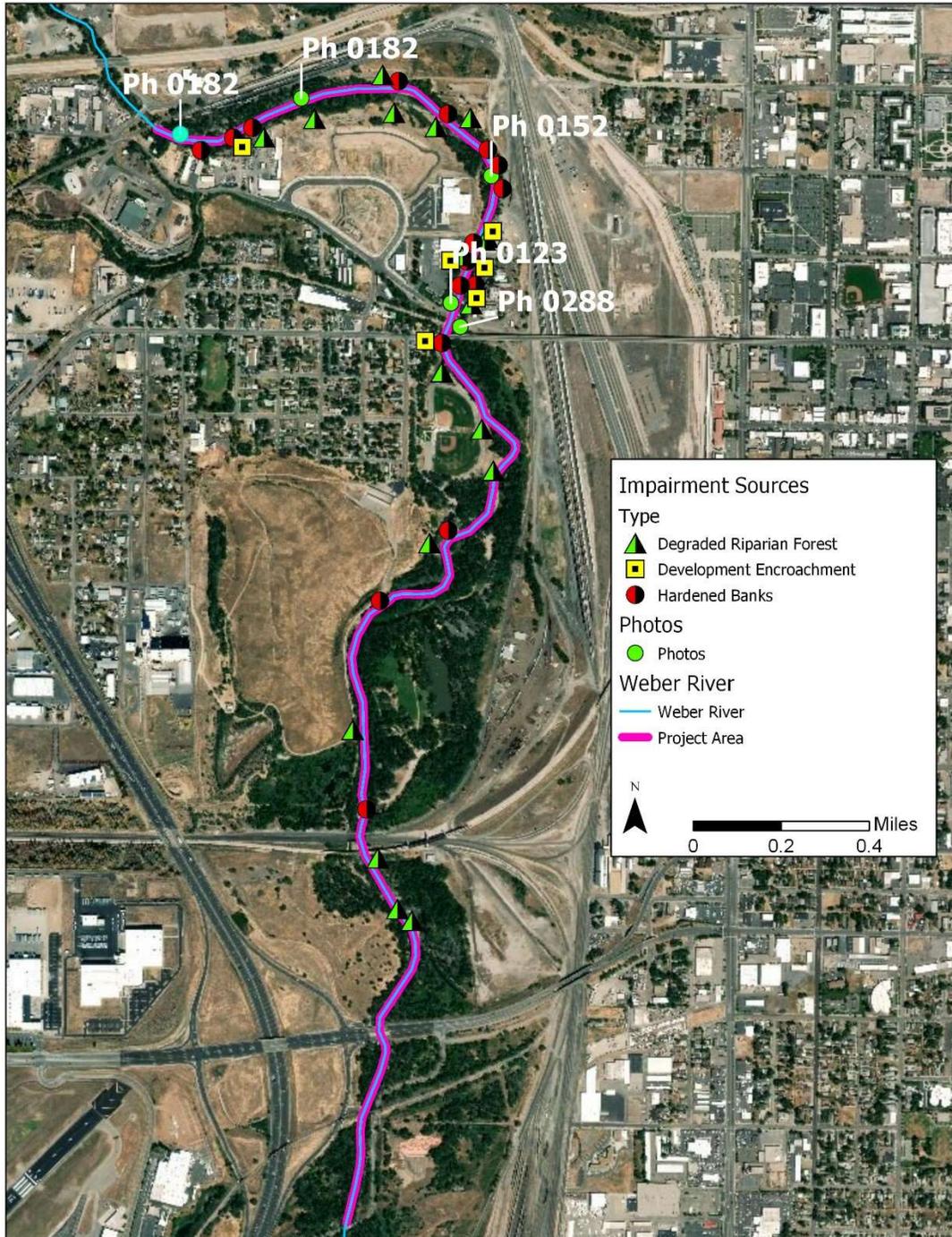


Figure 11. Locations of key sources of impairment of the project area. These sources of impairment are associated with suboptimal epifaunal substrate/available cover, bank vegetation protection, riparian vegetation zone width, habitat complexity and cover, and riparian vegetation cover and structure. Note also that the northern (downstream) portion of the project area has the most degraded conditions. Photos showing aspects of stream corridor degradation related to water quality are shown in the map above; photo numbers are provided in Figures 3-10.

The Weber River – Segment 3 is not listed for impairment in water quality criteria for human health or organoleptic effects (USEPA 2018). Human recreation impairments in the project area have reportedly not been assessed by the EPA (USEPA 2018). Recreational use of the project area is common. Recognized impairments in cold water aquatic life – identified by bioassessment - indicate cause for concern related to human health and recreational use.

Concern has been raised about high levels of total ammonia in the Lower Weber River (e.g., UT16020102_001) and nearby waterbodies; however, the UTDWQ reports that Weber River – Segment 3 does not have chronically high levels of total ammonia (UDEQ 2018).

3. CAUSES AND SOURCES OF POLLUTION

The EPA has identified hydromodification as one of the leading sources of impairment in our nation's waters. Three major types of hydromodification activities are categorized as changing a waterbody's physical structure and ability to maintain natural functions; these are channelization and channel modification, dams and streambank erosion. The modification of hydrology and river features (hydromodification) are intended to provide benefit to humans (e.g., levees for reducing flooding, electricity from hydroelectric dams, or bulkheads and hardening banks to reduce erosion and protect property). The unintended consequences from these human-induced stressors has disrupted natural channel processes, altered riparian and wetland habitat, and degraded biologic integrity.

Hydromodification is a leading NPS pollution affecting the biological integrity of the Lower Weber River. As the city of Ogden was urbanized the proportions of impervious area increased resulting to increases in the volume of runoff and storm water discharge. The river was encroached upon by adjacent development. The hydraulic changes associated with urbanization were addressed with channelization and channel modification as a solution. Consequently, these human induced stressors have impacted the Weber River. Physical and Biological impacts to the Weber River-Segment 3 channel are:

- Reduced macroinvertebrate diversity and abundance,
- Reduced biologic diversity,
- Reduced aquatic diversity,
- Habitat heterogeneity
- Fragmented and reduced riparian forests,
- Disconnected floodplain,
- Increased risk of flooding,
- Decreased wetland perimeter of the stream,
- Destabilized stream banks,
- Increased stream crossings and potential fish barriers,
- Increased presence of culverts and bridges
- Increased summer stream temperatures,
- Direct storm water discharge,
- Greater sediment load,
- Excessive litter in the channel and banks,
- Decline in water quality, and
- Reduced dry weather flow.

These impacts have caused physical changes such as; an increase in stream velocity, decreased overbanking flows, erosion of the stream bank, hardening of the stream bank, decreases in pool and riffle habitat, buried instream habitat, channel incision, channel narrowing, and an unstable channel.

These impacts have caused biological changes such as; decrease in the diversity and abundance of macroinvertebrate populations, decrease in fish migration and spawning habitat, and decrease in the diversity and abundance of riparian and wetland habitat.

Habitat heterogeneity caused by hydromodification is likely responsible for the reduction in species diversity and the increased abundance of those species favored by the alterations. For example, channelization has created a more uniform stream channel that is void of the pool and riffle habitat complex. In some areas, the channel is aggraded with fine sediments that fill void spaces important for macroinvertebrate habitats, food sources for fish, and spawning habitat. In some areas, over bank and historic overflow channels have been disconnected and silted in, causing an encroachment of riparian vegetation reducing the channels capacity for flood flows and overbanking to support adjacent riparian forests. Riparian forests have been homogenized and deteriorated by invasive species.

Urban runoff and direct storm water discharge have resulted in changes to the channel including increases in localized volume of flow; chemical changes such as increased organic input, increased turbidity and TDS, decreases in DO, increased volatile organic compounds, pesticides, and nutrients.

The cumulative impacts from urban development and associated NPS hydromodification, and increased storm water discharge, have negatively impacted macroinvertebrate populations and caused the Weber River-Segment 3 to be listed as 303(d) impaired to cold water aquatic life beneficial uses.

4. LOAD ALLOCATION AND REDUCTION

The Lower Weber River (Segment 03) is listed on the Utah 303(d) list of degraded waters due to poor benthic macroinvertebrate assemblages, which do not support the designated use as a cold-water fishery. Macroinvertebrate samples from 2004-2014 have continuously been observed (O) to have lower diversity with more pollution tolerant species that are expected (E) using RIVPACS type predictive models (UDWQ 2016). While a specific cause has not been scientifically proven, hydromodification of the channel, disassociated floodplain wetlands, poor riparian conditions, and inputs from urban runoff have been the primary culprits in other urbanized watersheds. This report focuses on the potential to increase the condition and quality of the river ecosystems by focusing on improvement of the natural characteristics of the channel by removing levees, digging side channels, and improving riparian conditions along the most urbanized reach of the Weber River through Ogden City.

Specific pollution loads are difficult to quantify and calculate, since multiple variables of physical channel condition is likely driving poor macroinvertebrate assemblages. The unnatural disturbance and alteration of the channel was used to identify hydromodification and to quantify the pollution loads. RiverRestoration observed the channel configuration and riparian conditions along the river in 2015-2016, measuring channel cross sections, longitudinal profiles, and riparian plant communities along a 3-mile reach of the Weber River through the City of Ogden. This assessment provided a basis for identifying the biological and physical degradations to develop a load allocation and anticipated load reduction to water quality impairments.

The river has been channelized in the sub-watershed to support development over the last 100+ years. Approximately one mile of the river is significantly channelized. The lateral connectivity of the main channel to floodplain wetlands has been cut off along approximately 1.6 linear miles of river in this reach. Riparian conditions are good along some of the reach, but approximately one mile is in fair to poor condition.

Areas outside of the City of Ogden, within Segment 3, will be addressed by Weber Pathways, Rocky Mountain Power, and other partners. In general, upstream of Ogden, the presence of the railroad to the north and I-84 to the south have encroached upon the broad floodplain that used to extend across the valley extending from the mouth of Weber Canyon to Riverdale. This encroachment creates a situation where flood flows are accelerated between hardened streambanks, increasing water velocities during floods and increasing sediment transport out of this upper reach, which gets deposited in the City of Ogden. This was apparent in the floods of 2011, where extensive sediment deposits adjacent to the Serge Simmons Ball fields caused the Weber River to aggrade and form a channel avulsion that cut across the ball fields. Additionally, sediment was deposited in the river adjacent to the Ogden Business Exchange, decreasing the flood flow capacity and exacerbating erosion of the streambanks.

The Weber River Watershed is a large area and different efforts over the last 20 years have been done to assess the water quality and pollution controls needed. Three TMDLs have been completed in the upper watershed, barriers to fish movement have been documented, water quality improvement actions have been taken, and significant outreach to the public and others has led to more awareness about human actions that have caused water quality to become degraded. The focus of this report is a lower sub-watershed adjacent to the most urbanized segment of the Weber River and is designated - UT 16020102-017: Weber Lower Tributaries-1. Many of the upper sub-

watersheds were addressed in the Weber River Watershed Plan (USU 2014) and that assessment will not be detailed here.

Best management practices recommended herein are to reduce hydromodification by restoring channel stability and floodplain connection, and to restoring aquatic and riparian habitats to a more functioning ecosystem within the heavily urbanized reach and to increase habitat quality, complexity, and connectivity in the upper reaches.

The recommended best management practices are anticipated to improve water quality and reduce degradations. Flow management, reduced channel forming flows and low flows are not addressed herein. Other groups are working to maintain adequate low-flows in the Weber River through the Weber Partnership. These groups include Trout Unlimited, Utah Division of Wildlife Resources, and others who are working with Rocky Mountain Power on the Weber Hydro Facility Relicensing. Through the Partnership those groups are also working with water users throughout the watershed to improve instream flows where possible.

The City of Ogden and other interested partners along the Lower Weber River Sub-watershed are working together to improve aquatic and riparian habitat conditions and connectivity in and adjacent to the river. The expected improvements include increasing the lateral and longitudinal connectivity of the river through removal and softening of streambanks within the channelized areas. Removal of rip rap, reconnection of the floodplain, improved diversity in substrate characteristics, and increasing the amount of backwater habitats is expected to improve the physical conditions that support different life cycles of many fish and benthic macroinvertebrates. Invasive species control, plant community diversification, and an increase in the area of riparian forests connected to the river is expected to provide more diversity in food sources, nesting areas, reduce channel temperatures, and improve the overall biological habitat along the river. These improvements in aquatic habitat diversity and riparian habitat complexity are expected to improve water quality for cold water aquatic life.

Best management practices identified herein are general recommendations, site specific measures at each project site are anticipated to improve the condition of both physical and biological habitats and associated water quality. In order to achieve that goal, a specific set of objectives has been developed and specific projects are proposed to meet each objective. The specific objectives to meet the goal of improving river function are as follows:

Objective 1 – Increase diversity and complexity of aquatic habitats to benefit aquatic organisms including both benthic macroinvertebrates and fish.

Objective 2 – Increase diversity and complexity of riparian habitats adjacent to the river to benefit both aquatic organisms listed above and riparian birds, including neotropical migratory birds, waterfowl, and other aquatic avian species.

Objective 3 – Develop local stewardship of the river by providing opportunities for local groups and individuals to get involved with river and riparian improvements.

Objective 4 – Enhance the quality of life for residents and visitors by improving ecosystems that are accessible to multiple user groups.

These four main objectives drive the recommended management measures which are focused on improvement of habitats, and secondarily focused on improving the social and economic values of the river.

Water quality degradations and associated load allocation within the Sub-watershed are as follows:

- 3.2 miles of hydromodification
- 0.85 miles of unstable channel
- 0.4 miles of unstable stream banks
- 126.5 acres of degraded riparian and wetland habitat
- 12 direct storm water outlets
- 3 barriers to aquatic life
- 87 acres of encroachment and loss of floodplain connection

DESCRIPTION OF BEST MANAGEMENT PRACTICES (BMP'S)

There are a variety of management activities that can reduce the NPS pollution impacts associated with urban development. Implementation of the recommended management measures below are intended to guide operation and maintenance activities, redevelopments, and new developments in the Lower Weber River Sub-watershed.

BMP 1: Education for New Construction and Operation and Maintenance Activities: Category 3 waters are reviewed under Anti-Degradation Review (ADR) policy and are therefore reviewed under CWA permitted activities. Under review for CWA permits; encourage public and private participation to design and implement projects upholding to the BMPs outlined herein. This will guide the planning process for new hydromodification projects to address changes to the physical and chemical characteristics of the channel that may occur. For existing projects, this will guide operation and maintenance programs to maximize opportunities to improve the physical and chemical characteristics of the river.

BMP 2: Establish a Buffer Zone: This is a fundamental recommendation in all river corridor planning projects. Whereas, where ever feasible, let the river have room to maintain geomorphic functions and stability. For example, where the bike path has been damaged from flooding, do not reconstruct the path in the same alignment. While land acquisition and easements may seem burdensome, the benefit of providing adequate room for the river to function may result in long term cost benefit advantages due to decrease closures, maintenance and repairs. Promote institutional measures that establish minimum setback requirements, or measures, that allow a buffer zone to reduce adverse hydraulics, concentrated flows, trampling of the bank, and promote infiltration of the hyporheic zone of the streambank and overbank areas.

BMP 3: Biostabilize Streambanks: Protect streambanks from erosion caused by adverse hydraulics and pedestrian access trampling. Reduce the amount of hardened and ripped banks that cause an increase in velocity and disconnect riparian functions. Where feasible lay back stream banks to improve the conveyance of the main channel and reduce bank shear stress.

BMP 4: Storm Water Source Buffering: Minimize the direct loading of pollutants routing the transport and/or delivery of pollutants through deposition zones and riparian and wetland buffer areas that intercept and remediate the pollutant before it is infiltrated/transported back into the main waterbody.

BMP 5: Create Interior Floodplains: Where possible, provide overflow channels and backwater areas to help attenuate and convey flood flows, slow channel velocities, and connect riparian and wetland areas.

BMP 6: Offset Flood Berms: Many areas of the channel have flood berms that provide inadequate flood protection to adjacent developments. Many of these berms are discontinuous, providing opportunities for flood flows to either flow, or backwater, providing little overall protection to adjacent development. Many of these berms are located too close to the river, eliminating the connection of the floodplain and reducing overall flood flow capacity. Reconstructing these berms at the limits of the floodplain, or at a maximum possible area adjacent to private property provides continuous and longer term flood protection and improves the geomorphic functions that support aquatic and biological habitats.

BMP 7: Instream and Riparian Habitat Restoration. Restore physical habitats impacted by hydromodification. Restore pool and riffle habitat complexes and balance sediment aggradation/deposition. Restore and create diversified riparian and wetland habitats through invasive species control, native plantings, and connecting buffer areas to the main channel.

CURRENT IMPLEMENTATION PLANNING AND SPECIFIC PROJECTS

The Lower Weber River Segment 03 has been divided into three main reaches and each reach has between one and five specific project areas to facilitate a phased approach to improving river conditions (see Figures 12-14 for maps of the areas). The reaches and projects are defined as:

REACH 1 – CONFLUENCE OF OGDEN RIVER AND WEBER RIVER UP TO OGDEN CITY LIMITS

Reach 1 is the most highly urbanized reach within the study area. There are five proposed project areas within this reach (Figure 12).

1. **The Ogden Business Exchange:** This reach is significantly encroached and is located between 21st South and 24th South streets in the City of Ogden. The confluence of the Ogden and Weber Rivers marks the downstream end, and the Marriot-Slaterville Diversion marks the upstream end of the reach.
2. **Serge Simmons Area:** This reach has some encroached areas, but also has riparian corridors as wide as 300 feet in some locations. The general location is above the Marriot-Slaterville Diversion up to Fort Buenaventura Park and includes riparian areas between the Union Pacific Railroad and Serge Simmons Ball Park.
3. **Fort Buenaventura Park:** This reach is terraced on the west side due to a capped landfill and has riparian areas in fair condition to the east. The general boundaries of the reach are the bridge that accesses Fort Buenaventura downstream and the Union Pacific Railroad Bridge upstream.
4. **32nd Street Outfall:** This reach is also adjacent to the old landfill, but a thin riparian corridor ranging from 70-400 feet exists on the west side of the river. The east side of the river has a riparian corridor that is approximately 350 feet in width. The general boundaries of this reach are the Union Pacific and Front Runner bridges on the downstream up to 31st Street on the upstream end.
5. **Parker Drive Riparian Area:** This reach is generally in a natural condition but is constrained partially by Parker Drive and the Weber River Parkway, a few bridges, and some rip rapped banks. The reach extends from 31st Street at the downstream end to the City of Riverdale on the upstream end.



REACH 2 – UPSTREAM OF OGDEN CITY THROUGH THE MOUTH OF WEBER CANYON

Reach 2 continues upstream through Riverdale, Uinta, and Weber/Davis County to the mouth of the Weber Canyon and is slightly less urbanized than Reach 1. The significant constraints on the natural geomorphic function through this reach are the Union Pacific Railroad to the north of the river and I-84 to the south, which constrain the natural meander belt by as much as 75% (Figure 13).

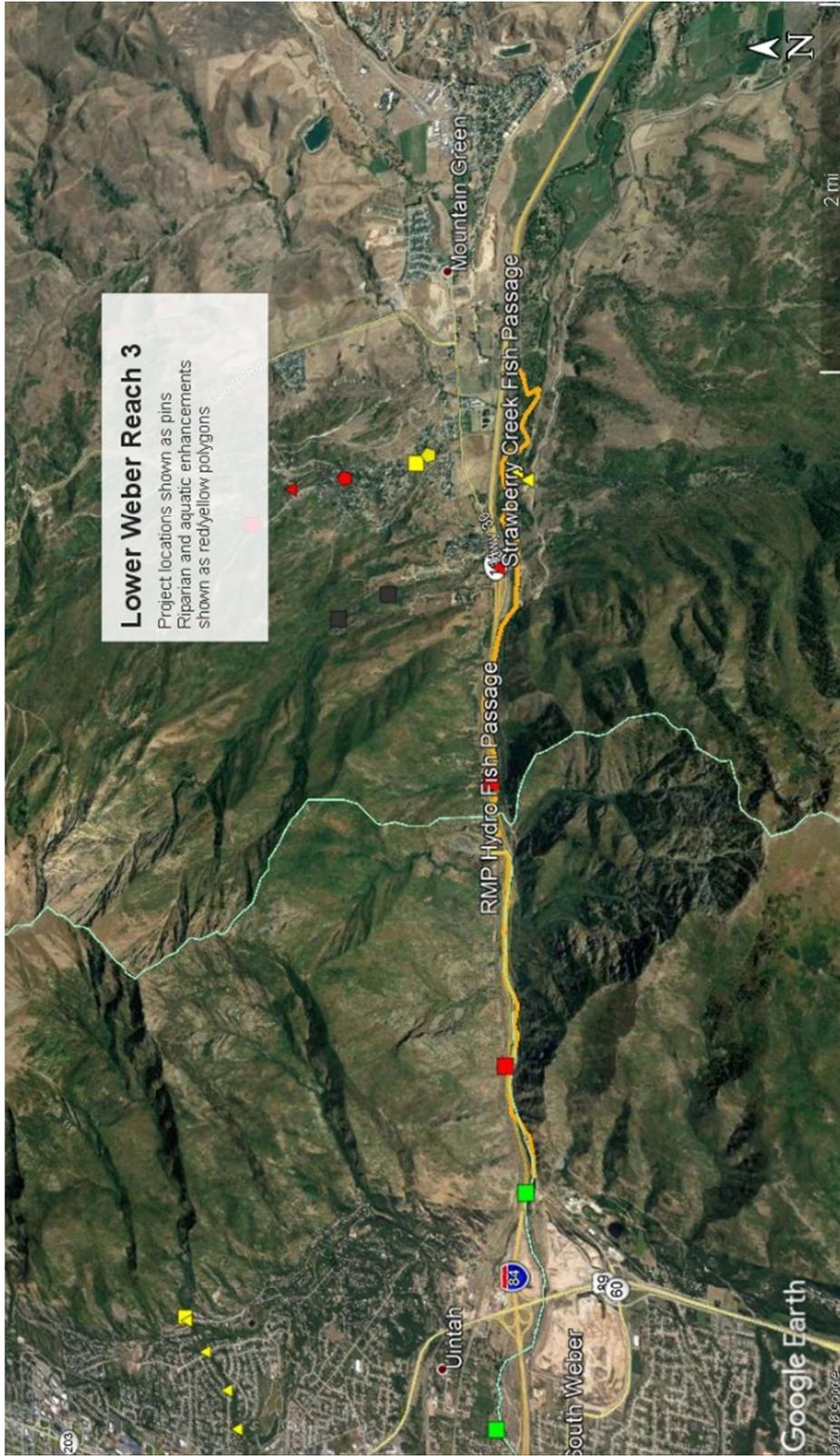
1. **Weber Pathways Bank Stabilization Projects:** There are several eroding banks and areas within this reach that will be addressed with biostabilization.
2. **Weber Pathways Blackner’s Bend:** The Blackner’s Bend Project area has proposed floodplain reconnection, riparian area enhancement and aquatic riffle-pool enhancement.



REACH 3 –MOUTH OF WEBER CANYON THROUGH THE CONFLUENCE OF COTTONWOOD CREEK ABOVE MOUNTAIN GREEN

Reach 3 is comprised of the confined Weber Canyon reach up into the downstream end of the Morgan Valley. The canyon reach is constrained by the Union Pacific Railroad and I-84, with steep sided rip rap banks and significant grade control. The main feature in this reach is the Rocky Mountain Power Hydroelectric Generation Plant in the canyon. There is one proposed project to increase fish passage at the hydro facility Figure 14.

1. **Rocky Mountain Power Weber Canyon Hydroelectric Generation Plant Fish Passage Improvement Project:** As part of the Federal Energy Regulatory Commission relicensing of the hydro power facility, RMP developed a fish passage and recreation access improvement project that will be implemented in 2020.



FUNDING NEEDS

A wide variety of funders are interested in the improvement of the Weber River for water quality, habitat, and recreational features. The City of Ogden is committed to leading the fund-raising effort and has identified City storm water management funds to provide a base for work each year. Other funding sources (including UDWQ/EPA NPS/319 funds) are being sought and have a high potential to provide additional resources. Table 1 shows the proposed funding sources. The 32nd Street Outfall work is planned for the winter of 2019 and the City of Ogden has directly funded \$150,000 and provided \$150,000 in-kind match for riparian easements, with another \$20,200 pending funding from the Utah Watershed Restoration Initiative for aquatic habitat enhancements and water quality improvements.

Table 1. Potential list of funding sources for 2017-2021*					
Source	Year				4-yr TOTAL
	2018	2019	2020	2021	
City of Ogden	\$75,000	\$75,000	\$250,000	\$150,000	\$550,000
Private Donors		\$50,000	\$75,000	\$50,000	\$175,000
FEMA HMGP		\$265,711	\$100,000	\$100,000	\$465,711
Utah Habitat Council / WRI	\$36,000	\$20,200	\$75,000	\$75,000	\$206,200
Utah Water Quality (NPS/319)		\$149,466		\$60,000	\$209,466
Utah Outdoor Recreation Grants		\$150,000		\$150,000	\$300,000
Utah Endangered Species Mitigation Fund			\$95,000		\$95,000
Weber Pathways		\$45,000		\$15,000	\$60,000
Trout Unlimited	\$5,000	\$5,000	\$5,000	\$5,000	\$20,000
TOTAL Potential Funding Sources	\$116,000	\$760,377	\$600,000	\$605,000	\$2,081,377
* Note - this table does not reflect match for accounting purposes					

Mid-term milestones:

- Develop a volunteer and Utah Conservation Corps partnership for riparian, wetland, trail and overland restoration implementation, management, and monitoring.
- Work with Ogden City Planning Department to adopt development setbacks and reduce channel encroachments.

Long-term milestones:

- Develop additional partnerships with Weber County, Morgan County, Riverdale City, Marriot/Slaterville, South Ogden and other local governments to adapt management measures within this Plan, and link to other reaches within the Lower Weber River Ecological System.
- Encourage Ogden City planning for new and redevelopments to reduce impervious surfaces, increase buffer areas, and where possible daylight tributaries and habitat connection to the mainstem.
- Engage urban and suburban communities in neighborhood-scaled projects to reduce the transport of sediment, nutrients, and *E. coli* to storm water drains.

5. WATER QUALITY CRITERIA

Developed herein, are site specific criteria and narrative standards to evaluate the biological integrity of the Lower Weber River Sub-watershed. “Biological integrity” means the capacity of a water body to support and maintain a balanced, integrated, adaptive community of organisms that has species composition, diversity, and functional organization comparable to that of the natural habitat of the region.

SPECIFIC CRITERIA TO MEASURE SUCCESS

Hydromodification Reduction -

(Geomorphic and physical criteria):

- Reduced in-channel hazard (#)
- Restored fish passage (Bluehead Sucker) (#)
- Reduced channelized area (acres)
- Restored stream banks (lf)
- Area of connected floodplain (acres)
- Buffered storm water outlets (#)

(Biological criteria):

- Area of restored/created riparian vegetation (acres)
- Area of restored/created wetlands (acres)
- In-channel habitat enhancements (acres)
- Macroinvertebrate population diversity and abundance (O:E ratio)
- Bluehead Sucker abundance (#)

(Social criteria):

- River access areas (#)
- Educational signs (#)
- Community engagement (participants/yr)

7. WATERSHED IMPLEMENTATION STRATEGY

Project Name	BMPs Recommended	Load Reduction and WQ Benefits
Ogden Business Exchange	1 ,2, 3 ,4, 5, 7	-1.5 acres of connected floodplain -1,200 lf restored streambanks -38 acres of restored riparian habitat -2.75 acres reduced channelized area -3 fish barriers removed -3 in-channel hazards removed -2 buffered storm water outlets -2 educational signs -1,200 feet trail connection -2 concentrated river access areas
Serge Simmons Area	1, 5, 7	-12 acres of connected floodplain -3.5 acres of restored riparian area -4,140 sq-ft of wetland habitat -0.50 acres of side channel habitat -0.85 acres enhanced in-stream habitat -445 lf of stabilized streambank -2 concentrated river access areas -1 educational sign
Fort Buenaventura Park	1, 3, 5, 7	*Place holder for DWR
32nd Street Outfall	1, 2, 4, 5, 6, 7	-1.5 acres of connected floodplain -2 acres restored riparian area -0.2 acres of backwater habitat -0.8 acres of wetland habitat

		-1 buffered storm water outlet
Parker Drive Riparian Area	1, 2, 3, 7	-57 acres of restored riparian habitat -0.3 acres of wetland habitat -1 buffered storm water outlet

8. EDUCATION AND OUTREACH

The focus for education and outreach for the Lower Weber River Sub-Watershed Plan will be to develop community support through engagement of local schools, trout unlimited local chapter, City of Ogden community volunteer program, and other interest groups. The following 2 goals have been developed and will be implemented with partners. Additionally, stakeholders will be engaged with the project through continued correspondence through the Weber Partnership. Utah Water Watch will also be engaged in developing a citizen science program in partnership with Weber State University.

Goal 1: Develop Community Stewardship and Support

One of the main emphasis of this Plan is to develop community stewardship and support for the implementation of identified projects. The intent for site specific education and volunteer opportunities, is to engage the greater community and expand enthusiasm for a corridor-wide support network within Segment 3 and adjacent tributaries and reaches. To achieve this goal, the City of Ogden, along with the Weber Partnership are developing strategies and opportunities to reach out to community interest groups. Utilizing the Weber Partnership interface and broader scale network, a short presentation will be developed to organize events and opportunities for those with limited time and/or busy schedules.

Task 1.1: Engage interested citizens in citizen science and community stewardship actions

Task 1.2: Identify opportunities to build stewardship ethic in local communities

Task 1.3: Develop communications with interested citizens

Outcomes and priority needs related to Goal 1: Developing community stewardship and support for Projects specifically, will support both the implementation and sustainability of community-based conservation projects. This Plan focuses on a highly-utilized river corridor in the heart of Ogden, with a primary objective of each Project site is education and community connection to the river. Integrating site specific art, science, and volunteer opportunities develops stewardship through classroom enrichment, real outdoor conservation experiences, and ownership for deep-rooted appreciation of the Weber River.

Goal 2: Develop and implement Weber River focused environmental curricula and Place-based learning in public education

Implementation of this Plan presents tremendous opportunities to involve middle and high school public school teachers, and their students located in the general area of the project in long-term, place-based learning initiatives. These initiatives would begin with professional development trainings for middle and high school teachers and would continue the development and application of a Weber River-focused curriculum that aims to improve students' environmental literacy and enhance their environmental stewardship and leadership. The Center for Documentary Expression and Art (CDEA) has developed an innovative, eight-week, art-science curriculum for teachers and students in grades 7-12 that will form the basis of the project's educational component. The curriculum has four parts and involves (1) study of the nation's developing environmental awareness, (2) study of the natural and human history of the Weber

River, (3) guided field trips, restoration work, and clean-up of the river, and (4) photography and writing about the river and its issues. The educational project will help build an environmentally educated student and teacher cohort while also providing an engaged and reliable student volunteer group for restoration and clean up. Over the past four years, CDEA has worked with 7th-grade students in Salt Lake City with the Jordan River Commission. This proposal will extend the program to include local Ogden Schools. Future schools may be added if additional funding becomes available.

Task 2.1: Engage with faculty to implement a residency plan.

Task 2.2: Implement the eight-week, place-based, art science residency curricula for students in grades 7-12, and develop additional environmental education materials and activities as needed

Task 2.3: Coordinate place-based learning events

Outcomes and priority needs related to Goal 2: Developing and implementing place-based learning will engage partners in the public schools and local artists and scientists. The requested grant funding will provide measurable education outcomes in the form of curricula, student involvement in outdoor service, increased knowledge of conservation issues, photographs, creative writing, and visual art, culminating in an exhibit of students' residency writing, photography, and drawing. Grant opportunities have been identified and applied for, to begin implementation of Goals 1 and 2 to start the process for long-term stewardship and vitality of the Weber River. Education and community connection to the river is the impetus for long-term stewardship and enhancing the natural, social and economic values of the Weber River.

9. MONITORING PLAN

This section summarizes the ongoing monitoring efforts within the Sub-watershed. Each project implemented shall develop a site-specific monitoring program for evaluating success, and making recommendations for adaptive management. Monitoring of the Weber River shall focus on biological, chemical, and social aspects of the resource. The UDWQ will continue to use the UCASE monitoring protocol to support water quality assessments. Additionally, the Western Center for Monitoring and Assessment of Freshwater Ecosystems will conduct a focused inventory of macroinvertebrates in the Project reach. Riparian surveys were completed by the City of Ogden in 2015 and site specific transects will be inventoried in areas of planned disturbance and revegetation. Chemical water quality sampling will continue with the Weber Basin Water Conservancy District in partnership with the UDWQ. The UDNR has worked with Utah State University and local partners to inventory the Bluehead sucker populations in the river and that work will continue in the future.

Site specific monitoring for each project implemented shall be performed to inform adaptive management measures. These may include:

- Cross Section Surveys
- Riparian Transects
- Photographic Monitoring
- Sediment Surveys
- Stream Bank Assessments
- Community Green Space Use Surveys

Monitoring Summary Table

Monitoring Parameter	Location	Frequency	Responsible Party
Water Quality Constituents:	Exchange Road Bridge; Ogden	12x year	UDWQ WBWCD
Macroinvertebrates	Ogden Business Exchange	3-5-year period	UDWQ WCMAFE Utah Water Watch
Fish Sampling	Accessible Sections	3-5 year period	UDWR
Site Specific Monitoring	TBD	TBD	Ogden City

10. REFERENCES

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11. APPENDICES

Appendix A. MCR Riparian Inventory

Appendix B. UWFWS species list

Appendix C. Water Quality Data from AQWMS

Appendix D. Concept Plans